(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 296 022 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
27.12.2023 Bulletin 2023/52

(21) Application number: **22755862.4**

(22) Date of filing: **26.01.2022**

(51) International Patent Classification (IPC):
B26B 19/48 *(2006.01)* ***B26B 19/46*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B26B 19/46; B26B 19/48

(86) International application number:
PCT/JP2022/002792

(87) International publication number:
WO 2022/176538 (25.08.2022 Gazette 2022/34)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **16.02.2021 JP 2021022219**

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

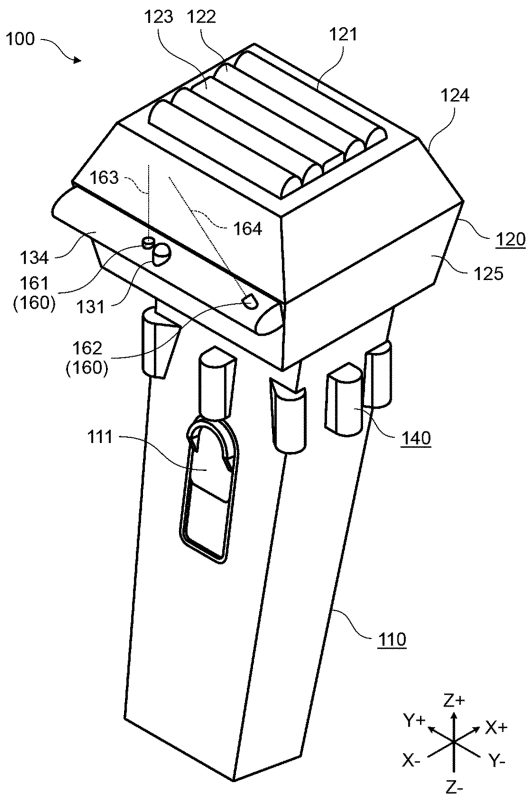
(72) Inventor: **KANAMORI, Yoshiaki**
Kadoma-shi, Osaka 571-0057 (JP)

(74) Representative: **Grünecker Patent- und Rechtsanwälte**
PartG mbB
Leopoldstraße 4
80802 München (DE)

(54) **ELECTRIC SHAVER**

(57) The present disclosure provides an electric razor that accurately detects a property of a hair in the case of a white hair. Electric razor (100) according to the present disclosure is electric razor (100) that includes grip (110) and head part (120) connected to one end of grip (110). The electric razor includes imaging device (131) that images a part near a skin with which shaving unit (121) comes into contact, illumination device (160) that can irradiate a region to be imaged by imaging device (131) with light rays in different directions, and an image processing device that processes an image acquired from imaging device (131). The image processing device includes an imaging control unit that controls illumination device (160) and imaging device (131) to cause the region to be imaged by being individually irradiated with the light rays in the different directions, and a property information generation unit that generates property information indicating a property of a hair based on an image imaged by imaging device (131).

FIG. 1



EP 4 296 022 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an electric razor for cutting a hair such as a beard.

BACKGROUND ART

[0002] In the related art, a shaving guidance system that comprises an imaging device that records an image of a body part of a user, and obtains a local hair growth direction based on an imaged image, and gives, to the user, an instruction about a direction and a place in which a shaving device is to be moved on the body in accordance with the obtained hair growth direction has been proposed (see, for example, PTL 1).

Citation List

Patent Literature

[0003] PTL 1: Japanese Translation of PCT International Application No. 2016-534806

SUMMARY OF THE INVENTION

Technical problem

[0004] However, in a system of the related art, in a case where a color tone difference between a skin and a hair is small, for example, a white hair in a person whose skin color is white, a color tone difference between the skin and the hair is small. Thus, it is difficult to separate the skin and the hair by image processing, and it is difficult to acquire information on a property of the hair.

[0005] The present disclosure has been made in view of the above problems, and an object of the present disclosure is to provide an electric razor capable of detecting a property of a hair having a small color tone difference from a skin.

Solution to problem

[0006] In order to achieve the above object, an electric razor of an aspect of the present disclosure is an electric razor that includes a grip to be gripped by a user, a head part having a shaving unit for cutting a hair, the head part being connected to an end of the grip. The electric razor includes an imaging device that images a part near a skin with which the shaving unit comes into contact, an illumination device that is configured to irradiate a region to be imaged by the imaging device with light rays in different directions, and an image processing device that processes an image acquired from the imaging device. The image processing device includes an imaging control unit that controls the illumination device and the imaging device to cause the region to be imaged by being individually irradiated with the light rays in the different directions, and a property information generation unit that generates property information indicating a property of a hair based on an image imaged by the imaging device.

Advantageous effect of invention

[0007] According to the electric razor of the present disclosure, the skin and the hair are effectively separated from each other and the property of the hair can accurately be detected by individually irradiating the hairs with the light rays in the different directions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Fig. 1 is a perspective view illustrating an electric razor according to an exemplary embodiment.
Fig. 2 is a perspective view illustrating a head part of an electric razor according to the exemplary embodiment.
Fig. 3 is a block diagram illustrating a functional unit of an image processing device of the electric razor according to the exemplary embodiment.
Fig. 4 is a perspective view illustrating another Example 1 of the electric razor.
Fig. 5 is a perspective view illustrating a head part of another Example 2 of the electric razor.

DESCRIPTION OF EMBODIMENT

[0009] Hereinafter, exemplary embodiments of an electric razor according to the present disclosure will be described with reference to the drawings. Note that the following exemplary embodiments are examples for describing the present disclosure, and are not intended to limit the present disclosure. For example, a shape, a structure, a material, a component, a relative positional relationship, a connection state, a numerical value, a mathematical expression, the contents of each step and the order of individual steps in a method, and the like described in the following exemplary embodiments are merely examples, and may include the contents that are not described below. In addition, geometric expressions such as parallel and orthogonal may be used, but these expressions do not indicate mathematical strictness, and include substantially acceptable errors, deviations, and the like. In addition, expressions such as simultaneous and identical include substantially acceptable ranges.

[0010] In addition, the drawings are schematic views in which emphasis, omission, and ratio adjustment are appropriately performed in order to describe the present disclosure, and may be different from actual shapes, positional relationships, and ratios.

[0011] In addition, hereinafter, a plurality of technical ideas may be comprehensively described as one exemplary embodiment. In addition, some of the contents to

be described below are described as optional components related to the present disclosure.

[0012] Fig. 1 is a perspective view illustrating electric razor 100 according to the exemplary embodiment. Fig. 2 is a perspective view of head part 120 of electric razor 100. Note that electric razor 100 has portions that include a rounded edge, and recesses and protrusions for preventing slippage, but these portions are not illustrated.

[0013] Electric razor 100 is a device that cuts and removes a hair such as a beard by using an electric blade, and includes grip 110, head part 120, imaging device 131, illumination device 160, and image processing device 150 (not illustrated in Fig. 1). In the present exemplary embodiment, electric razor 100 includes notification device 140.

[0014] Grip 110 is a portion gripped by a user when electric razor 100 is used. In the case of the present exemplary embodiment, grip 110 also functions as a housing for accommodating image processing device 150, a controller that controls the drive of a shaving blade, a battery, and the like. Power supply switch 111 or the like for turning on or off a power supply is provided on an outer surface of grip 110.

[0015] Head part 120 is a member that includes shaving unit 121 including a blade for cutting a hair and is connected to one end of grip 110. In the case of the present exemplary embodiment, head part 120 is relatively operably connected to grip 110. An operation direction of head part 120 is not particularly limited, but head part 120 is swingable in a circumferential direction with each of a front-back direction (X-axis direction in the drawing), a width direction Y (Y-axis direction in the drawing), and an up-down direction (Z-axis direction in the drawing) as an axial center.

[0016] Shaving unit 121 includes a plurality of (four in the present exemplary embodiment) first outer blades 122 in the front-back direction, each of which is semicylindrical and mesh-shaped, extends in the width direction, and has through holes, and second outer blade 123 which has slit-shaped through-holes and is disposed between first outer blades 122. First outer blades 122 and second outer blade 123 are attached to head frame 124, and shaving unit 121 is detachably attached to head base body 125.

[0017] First inner blades (not illustrated) provided to correspond to first outer blades 122 and a second inner blade (not illustrated) provided to correspond to second outer blade 123 are disposed inside head part 120, and an inner blade drive device for causing each of the first inner blades and the second inner blade to reciprocate in the width direction (Y-axis direction in the drawing) is provided. The inner blade drive device vibrates the first inner blades and the second inner blade, and thus, a hair inserted into the through-holes of first outer blade 122 and second outer blade 123 is cut between first inner blades and second inner blade that vibrate.

[0018] Imaging device 131 is a device that images a part near the skin with which shaving unit 121 comes into contact. In the case of the present exemplary embodiment, imaging device 131 has an angle of view at which, in a state where shaving unit 121 is brought into contact with the skin, a skin having a length corresponding to the entire of first outer blades 122 and second outer blade 123, which are the outer blades in the front-back direction (X-axis direction in the drawing) and a skin having a length corresponding to the entire width (Y-axis direction in the drawing) of first outer blade 122 in the width direction (Y-axis direction in the drawing) can be imaged at a time. Accordingly, states of a hair and a skin immediately before and after shaving can be accurately imaged.

[0019] A type of imaging device 131 is not particularly limited, and for example, a so-called digital camera including an optical system including a lens and the like and an imaging element that converts an image formed by the optical system into an electrical signal can be exemplified. In the case of the present exemplary embodiment, imaging device 131 can image not only an image based on light in a wavelength range of visible light but also an image based on light in a wavelength range of infrared light including near-infrared light.

[0020] Imaging device 131 is fixed to head base body 125 of head part 120, and imaging device 131 also operates together with an operation of head part 120 for grip 110. Accordingly, a distance between the skin and imaging device 131 can be stabilized even during shaving by electric razor 100, and a clearer image can be imaged. Specifically, as illustrated in Fig. 2, imaging device 131 is attached to a central portion of substrate 133 protruding forward from a front surface (X-side in the drawing) of head base body 125 in the width direction (Y-axis direction in the drawing). According to this, since imaging device 131 does not become an obstacle when head frame 124 is attached or detached, such an attachment is preferable. In addition, illumination device 160 such as a light emitting diode (generally referred to as "LED") that illuminates the skin within the angle of view of imaging device 131 is attached to substrate 133. Substrate 133 and imaging device 131 are covered with cover 134 (see Fig. 1).

[0021] Illumination device 160 is a device capable of irradiating a region imaged by imaging device 131 with light rays from different directions. Directions in which illumination device 160 irradiates a predetermined region are not particularly limited, but, for example, angles with respect to a normal line of a skin surface are different. Specifically, a case where light having an optical axis along the normal line of the skin surface is irradiated, and light having an optical axis intersecting the normal line of the skin surface at a predetermined angle (for example, 15° or more and less than 90°) is irradiated can be exemplified. In a case where the light having the optical axis along the normal line of the skin surface is irradiated, the skin surface is imaged in a relatively white color, and in a case where the light having the optical axis intersecting the normal line of the skin surface at a predetermined angle is irradiated, the skin surface is imaged in a rela-

tively black color. The inventor has found that, in a case where the skin surface is imaged in the relatively black, it is easy to distinguish and detect a white hair from the skin in the image.

[0022] An aspect in which illumination device 160 performs the irradiation of light rays from different directions is not particularly limited, but in the case of the present exemplary embodiment, illumination device 160 includes a plurality of light sources attached such that directions of optical axes are different. Specifically, illumination device 160 includes first light source 161 that emits light of first optical axis 163 and a second light source 162 that emits light of second optical axis 164. First optical axis 163 and second optical axis 164 pass through a central portion of the region imaged by imaging device 131 or a portion near the central portion in a state where shaving unit 121 comes into contact with the skin. In addition, both first light source 161 and second light source 162 irradiate the entire region imaged by imaging device 131. On substrate 133 to which imaging device 131 is attached, first light source 161 is attached relatively close to imaging device 131, and second light source 162 is attached at a position relatively distant from imaging device 131.

[0023] A type of the light source is not particularly limited, but examples thereof include a light source that emits white light based on a light emitting diode (LED). In a case where illumination device 160 includes a plurality of light sources, the light sources may emit light rays having the identical wavelength or the identical wavelength range, or may emit light rays having wavelengths of maximum peaks different from each other, for example. In the present exemplary embodiment, each of first light source 161 and second light source 162 includes a monochromatic LED and a wavelength conversion substance with light from the LED as excitation light, and emits light in a visible light region and a near-infrared region.

[0024] Notification device 140 is a device that notifies the user of a processing result of image processing device 150. The notification method of notification device 140 is not particularly limited, and examples thereof include a method for performing notification by sound (including voice), light, vibration, electrical stimulus, a combination thereof, or the like. In the case of the present exemplary embodiment, notification device 140 is a device that performs notification of information by light, and includes a plurality of light emitting elements such as LEDs arranged on a peripheral edge of an end of grip 110 close to head part 120. Notification device 140 can change at least one of brightness, color, and a light emission pattern of light.

[0025] Fig. 3 is a block diagram illustrating functional units of image processing device 150. Image processing device 150 is a device that controls illumination device 160 to process an image acquired from imaging device 131, and includes, as processing units implemented by a processor executing a program, imaging control unit 157 and property information generation unit 151. In the present exemplary embodiment, image processing device 150 further includes shaving information generation unit 152, result notification unit 153, and information acquisition unit 154.

[0026] Imaging control unit 157 controls illumination device 160 to individually emit light rays in different directions, and controls imaging device 131 such that an imaging timing of imaging device 131 is synchronized with a timing at which illumination device 160 is caused to individually emit light rays. In the case of the present exemplary embodiment, imaging control unit 157 controls illumination device 160 such that first light source 161 and second light source 162 alternately emit light rays, and controls imaging device 131 such that imaging is executed in accordance with a timing at which each of first light source 161 and second light source 162 emits light.

[0027] Property information generation unit 151 processes the image imaged by imaging device 131 with the light rays emitted to a predetermined region in different directions, and generates property information indicating a property of a hair. The property information is, for example, information including at least one of a length of a hair, a direction in which a hair is grown, and a density of a hair.

[0028] An example of a case where property information generation unit 151 generates the property information indicating the length of the hair will be described. Property information generation unit 151 performs processing of enhancing contrast on each of images based on light rays in a plurality of directions acquired by information acquisition unit 154. For example, property information generation unit 151 increases luminance contrast by performing, on luminance of each pixel of the image, gradation conversion for increasing a change in output gradation with respect to input gradation. Note that fine noise such as irregularities of the skin may be removed by applying a low-pass filter to the image before or after the contrast enhancement.

[0029] Subsequently, property information generation unit 151 performs contour extraction on the image in which the contrast is enhanced. More specifically, property information generation unit 151 removes fine noise by binarizing (that is, whitening/blackening) such that a white pixel is output in a case where a luminance difference with a peripheral pixel is more than or equal to a threshold and a black pixel is output in a case where the luminance difference is less than the threshold and then performs expansion and contraction processing. Note that the expansion and contraction processing refers to expansion processing of replacing a pixel of interest with white in a case where at least one white pixel is present around the pixel of interest, and contraction processing of replacing a pixel of interest with black in a case where at least one black pixel is present around the pixel of interest. By this contour extraction, an image showing contours of individual hairs is obtained.

[0030] Here, property information generation unit 151 may extract contours of hairs from a plurality of images of the identical region imaged based on the light rays emitted in the different directions, and may integrate the contours in the plurality of images. Accordingly, it is possible to effectively generate the property information of the hair even in a case where the black hair and the white hair are mixed, such as in a case where the black hair and the white hair are grown at substantially the same ratio. In addition, property information generation unit 151 may compare the plurality of images of the same region imaged based on the light rays emitted in the different directions, and may select one image according to a predetermined condition such as an image having a largest number of extracted contours. Accordingly, it is possible to accurately acquire the property information indicating the property of the hair for a hair having a color more frequently grown out of the black and white hairs.

[0031] Subsequently, property information generation unit 151 calculates a circumscribed rectangle for each region from which the contour is extracted. Specifically, property information generation unit 151 calculates the circumscribed rectangle for each region from which the contour is extracted such that the rectangular contour comes into contact with the region corresponding to the extracted hair. That is, a circumscribed rectangle surrounding a black portion is calculated for the black hair, and a circumscribed rectangle surrounding a white portion is calculated for the white hair. However, the calculation method of the circumscribed rectangle is not limited to this method, and any other method may be used as long as a rectangle covering the contour of the hair can be calculated in order to estimate a length of the hair. By the above processing, an image showing rectangles circumscribing regions corresponding to individual hairs including at least one of the white hair and the black hair is obtained.

[0032] Subsequently, property information generation unit 151 specifies the length of each hair by calculating a length of a long side of the circumscribed rectangle for each calculated circumscribed rectangle. For the specification of the length of the long side, the long side is set as an oblique side, lengths of two orthogonal sides in a right triangle including two sides along an orthogonal direction in which the pixels are arranged (here, a length of one side is given by the number of pixels $\times$ pixel interval) are calculated, and the length of the long side that is the oblique side is calculated by using the theorem of three squares. In addition, the direction of the hair may be calculated as the property information from the lengths of two orthogonal sides.

(Length and direction of hair)

[0033] By doing this, the lengths and directions of the individual hairs are specified from the image imaged by imaging device 131. Further, property information generation unit 151 performs statistical processing on the lengths and directions of the plurality of hairs included in the image, and generates information representing the lengths and directions of the plurality of hair in the image as numerically expressed property information. In the statistical processing, the length of the hair may be used as a weight, or only data of the length of the hair more than or equal to a predetermined length threshold may be used.

(Density of hair)

[0034] An example of a case where property information generation unit 151 generates the property information indicating the density of the hair will be described. The description is similar to the above description until property information generation unit 151 generates the image showing the contours of the individual hairs.

[0035] Subsequently, property information generation unit 151 calculates an area of each region from which the contour is extracted, and calculates a total area of each region in the image. Further, property information generation unit 151 generates a ratio of a total area of the rectangular region to an area of the image as numerically expressed property information indicating the density of the hair.

[0036] Shaving information generation unit 152 generates shaving information on shaving based on the property information generated by property information generation unit 151. The shaving information is information including at least one of a shaving direction and the end of shaving. For example, in a case where the property information indicating the hair length is less than or equal to a length threshold, shaving information generation unit 152 may generate shaving information indicating the end of shaving. In addition, in a case where the property information indicating the shaving density is less than or equal to a shaving density threshold, shaving information generation unit 152 may generate the shaving information indicating the end of shaving. In addition, shaving information generation unit 152 may generate shaving information indicating a shaving direction which is a direction in which shaving unit 121 is moved with respect to the skin.

[0037] In the case of the present exemplary embodiment, shaving information generation unit 152 may calculate a motion vector focusing on hair, skin texture, and the like from images imaged at predetermined intervals in the identical irradiation direction of light, and may generate shaving information of an excessive speed in a case where a speed obtained from the motion vector is more than or equal to a speed threshold. In addition, shaving information generation unit 152 may calculate a blur width of hair, skin texture, or the like from one image imaged at a predetermined shutter speed (that is, exposure time), and may generate the shaving information of the excessive speed in a case where the speed obtained from the shutter speed and the blur width is more than or equal to a speed threshold.

[0038] In addition, shaving information generation unit 152 may retain a plurality of thresholds having different values, such as a first length threshold that is 20% longer than the length threshold and a second length threshold that is 40% longer than the length threshold, and may generate shaving information that increases or decreases stepwise, such as shaving information corresponding to the level of the length of the hair.

[0039] After the property information becomes less than or equal to the length threshold and less than or equal to the shaving density threshold and the shaving information indicating the end of shaving is generated, in a case where the shaving information indicating the end of shaving is further generated from newly generated property information, shaving information generation unit 152 may generate shaving information indicating excessive shaving.

[0040] Result notification unit 153 controls notification device 140 to notify the user of the shaving information generated by shaving information generation unit 152. For example, result notification unit 153 notifies the user of the shaving information by controlling light emitted from a light emitting device included in notification device 140 to change at least one of the brightness, the color, and the light emission pattern. At a stage when the length of the hair is long, control is performed such that red light is emitted to notify the user of the non-end of shaving, and when the shaving information indicating the end of shaving is acquired from shaving information generation unit 152, control is performed such that blue light is emitted to notify the user of the end of shaving. Further, in a case where the user performs a shaving operation on a region where a hair having a length less than or equal to a length threshold is present, notification device 140 may be controlled to blink in red, and thus, the excessive shaving may be notified.

[0041] In addition, in a case where shaving information generation unit 152 generates the shaving information that increases or decreases stepwise, result notification unit 153 may notify the user of the stepwise shaving information by controlling the light emitted from the light emitting device to change at least one of the brightness, the color, and the light emission pattern stepwise. For example, the intensity of the light may be increased or decreased stepwise, or a blinking interval of the light may be increased or decreased.

[0042] According to electric razor 100 of the above exemplary embodiment, information on the hair is extracted from each image imaged by imaging device 131 based on the light rays irradiated from the plurality of directions regardless of the color of the hair, and the shaving information on the shaving can be notified to the user. Accordingly, the user can execute shaving processing while recognizing a speed at which electric razor 100 moves relative to the skin, the end of shaving in a predetermined region, and the like, and can efficiently perform a shaving operation regardless of the color of the hair together with suppression of damage to the skin.

[0043] Note that the present disclosure is not limited to the above exemplary embodiments. For example, another exemplary embodiment implemented by optionally combining the components described in the present description or by excluding some of the components may be an exemplary embodiment of the present disclosure. In addition, the present disclosure also includes variations obtained by making various modifications conceivable by those skilled in the art without departing from the spirit of the present disclosure, in other words, without departing from the meaning indicated by the wording described in the claims.

[0044] For example, in the above exemplary embodiment, although a case where illumination device 160 includes first light source 161 and second light source 162 having different attachment angles with respect to substrate 133 has been described, illumination device 160 may include light sources having the same attachment angle with respect to substrate 133 and having optical axes arranged in parallel, and as illustrated in Fig. 4, the optical axis of at least one light source may be different from the optical axes of other light sources by using optical axis changing member 165. Optical axis changing member 165 may include at least one of a light guide member and a reflection member.

[0045] In addition, as illustrated in Fig. 5, illumination device 160 may include optical path switching device 166 that switches an optical path of the light emitted from one first light source 161, and optical axis changing member 165 that changes an optical axis of one optical path to be switched. Optical path switching device 166 is not particularly limited, and examples thereof include a device that changes an angle of the reflection member and a device such as a liquid crystal that can electrically control transmission and reflection of light. In this case, imaging control unit 157 may control optical path switching device 166 of illumination device 160 to individually emit light rays in different directions.

[0046] In addition, imaging device 131 may be a so-called infrared camera that images an image based on infrared light. According to this, gloss of the skin can be suppressed, and an image having a large contrast difference between the white hair and the skin can be generated. In addition, the property of the hair can be accurately detected without being influenced by ambient light in an environment where electric razor 100 is used, for example, light from an illumination or the like attached to a wash basin.

[0047] In addition, even in a case where imaging device 131 detects light in a wide wavelength region to generate an image, property information generation unit 151 may extract an image having a wavelength in a specific region from the acquired image and may generate the property information based on the extracted image. According to this, for example, in a case where the extracted wavelength is in the infrared region, an effect similar to the effect in a case where imaging device 131 is an infrared camera can be obtained.

[0048] In addition, although notification device 140 including the light emitting element has been exemplified, notification device 140 may include a sound producing device such as a speaker, a vibration device that generates vibration in grip 110, an electrical muscle stimulation device that applies electrical stimulus to the hand gripping grip 110, and the like. Such notification device 140 can perform the notification of the shaving information by changing sound, vibration, intensity of electrical stimulus, a generation pattern, a direction, and the like.

[0049] In addition, in the above exemplary embodiments, although shaving unit 121 that includes a total of five outer blades including four first outer blades 122 and one second outer blade 123 has been exemplified, the number of outer blades is not particularly limited, and shaving unit 121 may include four or less outer blades or six or more outer blades.

[0050] In addition, shaving unit 121 may be configured to shave hair by rotating of the inner blade with respect to the outer blades.

[0051] In addition, the attachment position of imaging device 131 is not limited to the above exemplary embodiments, and may be attached to, for example, a rear side (X+ side in the drawing), a side (Y- side and Y+ side in the drawing), or the like. In addition, the first imaging device may be attached to grip 110. The number of imaging devices 131 is not limited to one, and may be attached to a plurality of places.

INDUSTRIAL APPLICABILITY

[0052] The present disclosure can be applied to electric razors capable of shaving hairs of animals including humans, such as so-called electric shavers for shaving beards and so-called hair clippers for shaving hairs.

[0053] Technical ideas derived from the present disclosure will be described below.

[0054] An electric razor derived from the present disclosure is an electric razor that includes a grip to be gripped by a user, a head part having a shaving unit for cutting a hair, the head part being connected to an end of the grip.

[0055] The electric razor includes:

an imaging device that images a part near a skin with which the shaving unit comes into contact;
an illumination device that is configured to irradiate a region to be imaged by the imaging device with light rays in different directions; and
an image processing device that processes an image acquired from the imaging device.

[0056] The image processing device includes:

an imaging control unit that controls the illumination device and the imaging device to cause the region to be imaged by being individually irradiated with the light rays in the different directions; and
a property information generation unit that generates property information indicating a property of a hair based on an image imaged by the imaging device.

[0057] In other words, an electric razor derived from the present disclosure is an electric razor that includes a grip to be gripped by a user, a head part having a shaving unit for cutting a hair, the head part being connected to an end of the grip.

[0058] The electric razor includes:

an imaging device that images a part near a skin with which the shaving unit comes into contact;
an illumination device that is configured to irradiate a region to be imaged by the imaging device with light rays in different directions; and
electrical circuitry which, in operation;
controls the illumination device and the imaging device to cause the region to be imaged by being individually irradiated with the light rays in the different directions; and
generates property information indicating a property of a hair based on an image imaged by the imaging device.

[0059] Examples of the electrical circuitry are semiconductor devices, such as an integrated circuit (commonly referred to as "IC") or a large scale integrated circuit (commonly referred to as "LSI").

REFERENCE MARKS IN THE DRAWINGS

[0060]

100	electric razor
110	grip
111	power supply switch
120	head part
121	shaving unit
122	first outer blade
123	second outer blade
124	head frame
125	head base body
131	imaging device
133	substrate
134	cover
140	notification device
150	image processing device
151	property information generation unit
152	shaving information generation unit
153	result notification unit
154	information acquisition unit
157	imaging control unit
160	illumination device
161	first light source
162	second light source
163	first optical axis
164	second optical axis

165 optical axis changing member
166 optical path switching device

Claims

1. An electric razor that comprises a grip to be gripped by a user, a head part comprising a shaving unit for cutting a hair, the head part being connected to an end of the grip, the electric razor comprising:

   an imaging device that images a part near a skin with which the shaving unit comes into contact;
   an illumination device that is configured to irradiate a region to be imaged by the imaging device with light rays in different directions; and
   an image processing device that processes an image acquired from the imaging device,
   wherein
   the image processing device comprises:

      an imaging control unit that controls the illumination device and the imaging device to cause the region to be imaged by being individually irradiated with the light rays in the different directions; and
      a property information generation unit that generates property information indicating a property of a hair based on an image imaged by the imaging device.

2. The electric razor according to Claim 1, wherein
   the illumination device comprises a plurality of light sources of which directions of optical axes are different from each other.

3. The electric razor according to Claim 1 or 2, wherein
   the illumination device includes an optical path switching device that switches an optical path to another.

4. The electric razor according to any one of Claims 1 to 3, wherein
   the imaging device and a light source of the illumination device are attached to an identical substrate.

5. The electric razor according to any one of Claims 1 to 4, wherein
   the imaging device performs the imaging based on infrared light.

6. The electric razor according to any one of Claims 1 to 5, wherein
   the property information generation unit generates the property information based on an image having a wavelength of a specific region.

FIG. 1

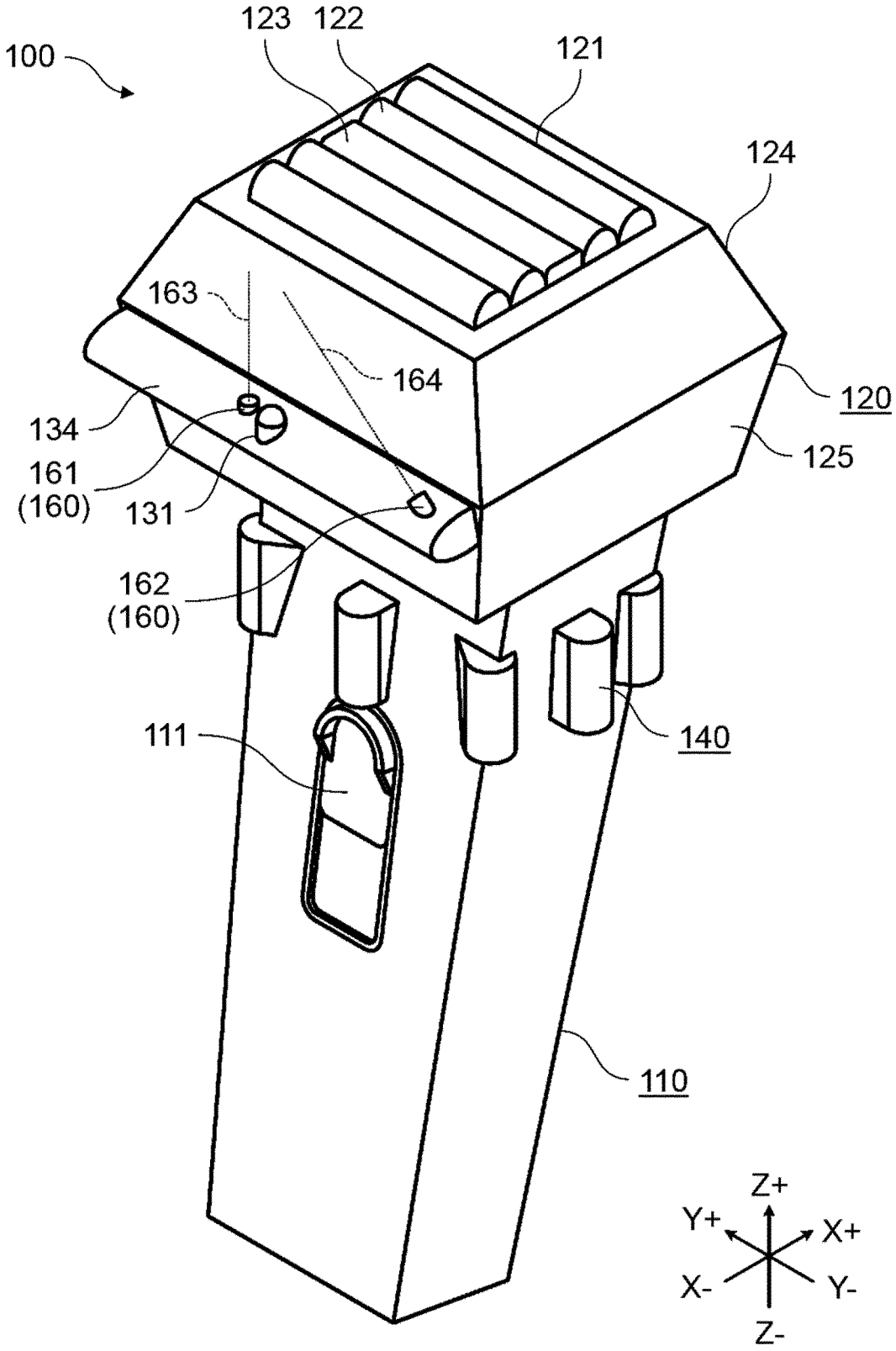

100
123
122
121
124
163
164
120
134
125
161
(160)
131
162
(160)
111
140
110
Z+
Y+
X+
X-
Y-
Z-

FIG. 2

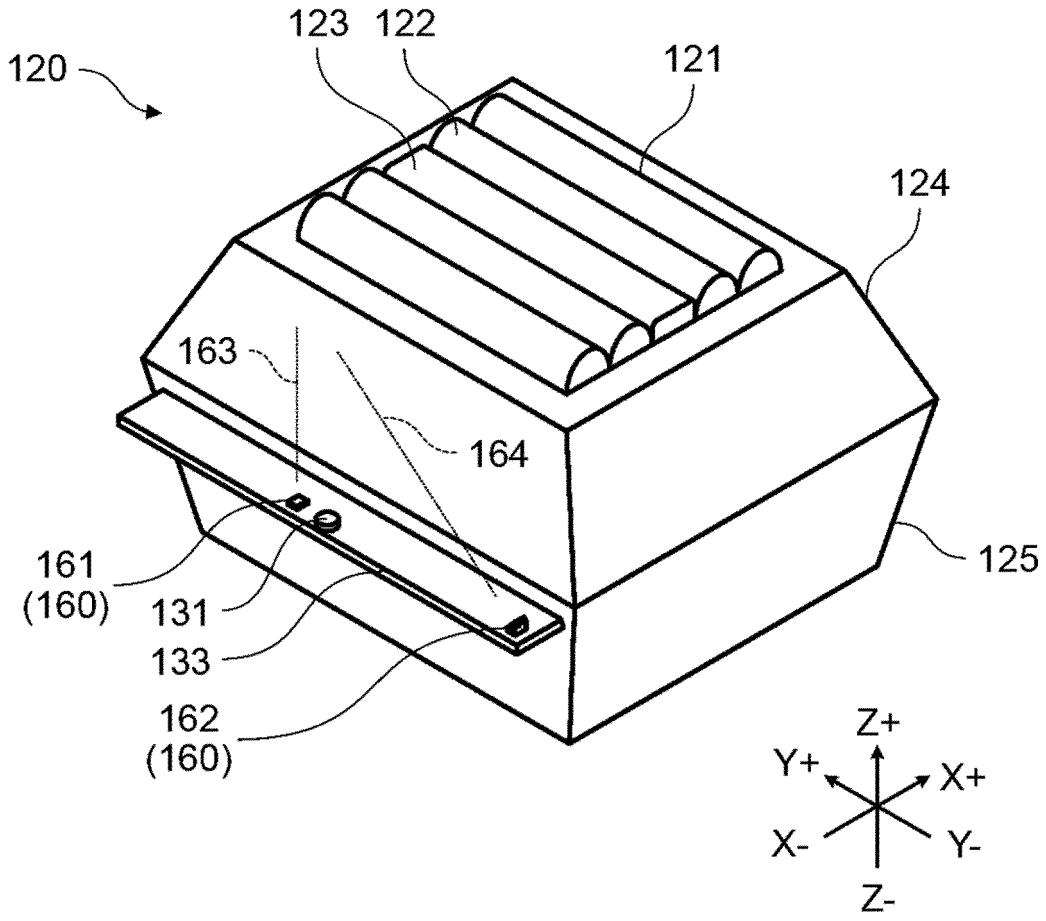


FIG. 3

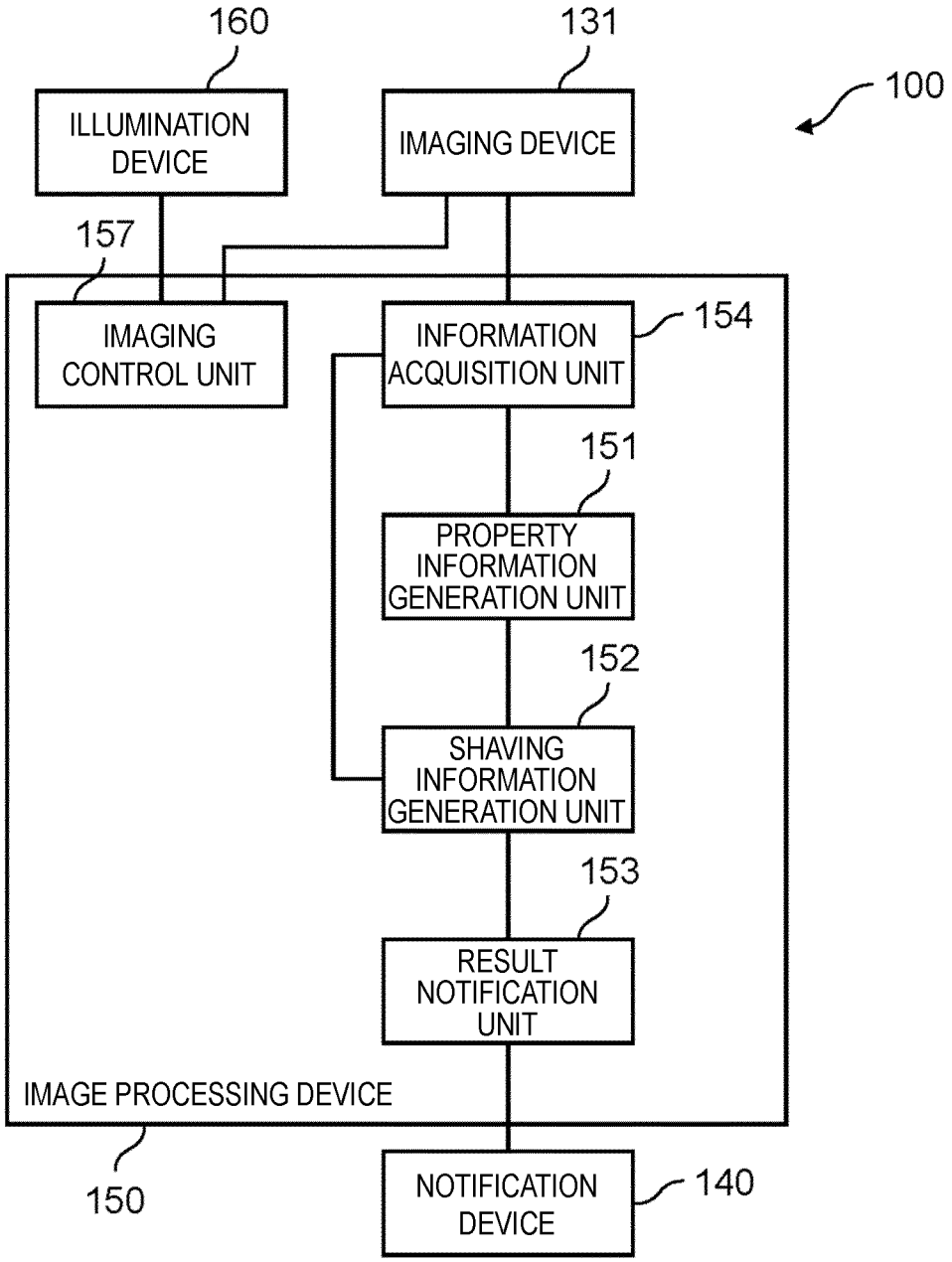

160
131
100
ILLUMINATION DEVICE
IMAGING DEVICE
157
IMAGING CONTROL UNIT
INFORMATION ACQUISITION UNIT
154
151
PROPERTY INFORMATION GENERATION UNIT
152
SHAVING INFORMATION GENERATION UNIT
153
RESULT NOTIFICATION UNIT
IMAGE PROCESSING DEVICE
150
NOTIFICATION DEVICE
140

FIG. 4

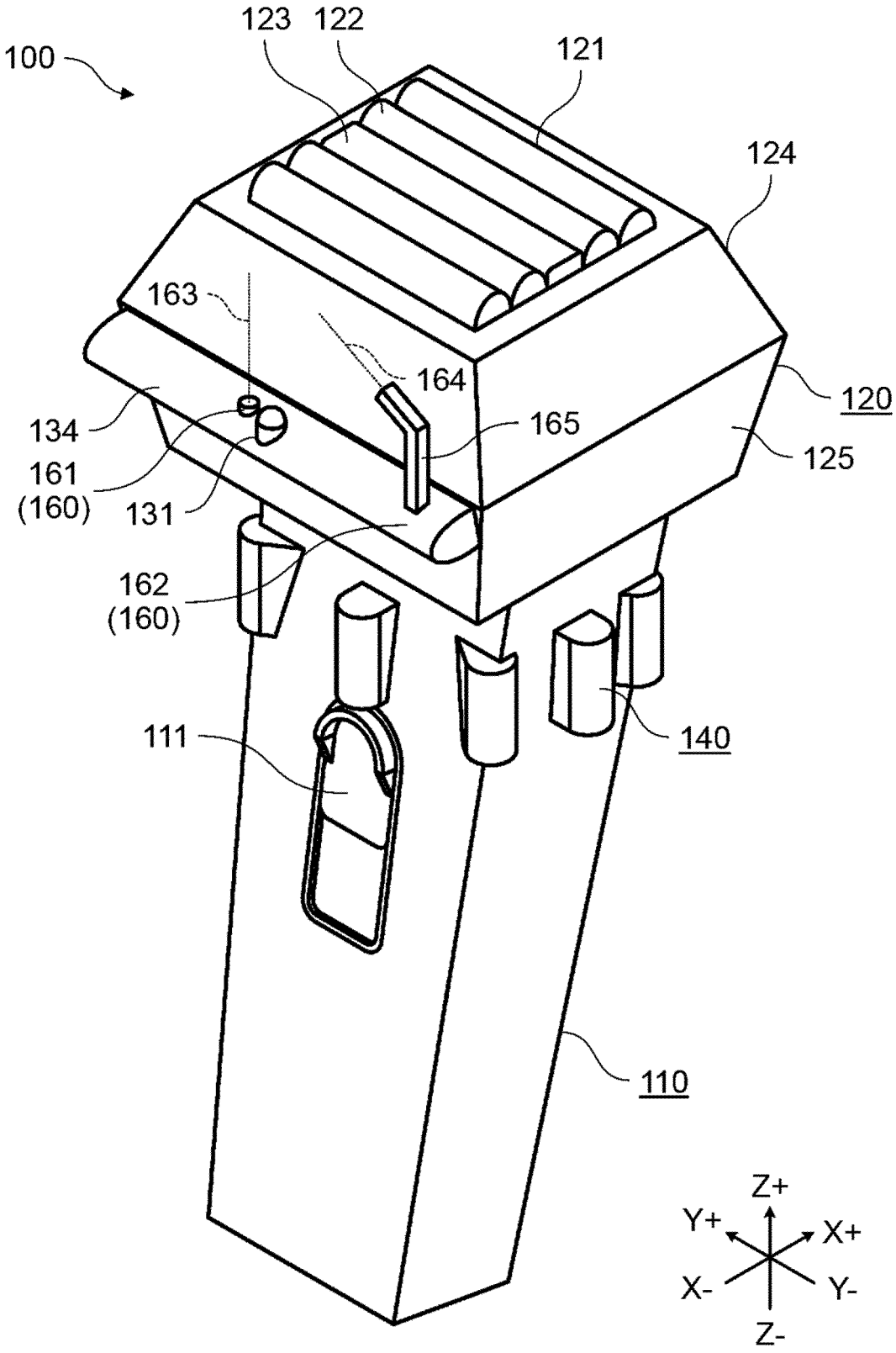
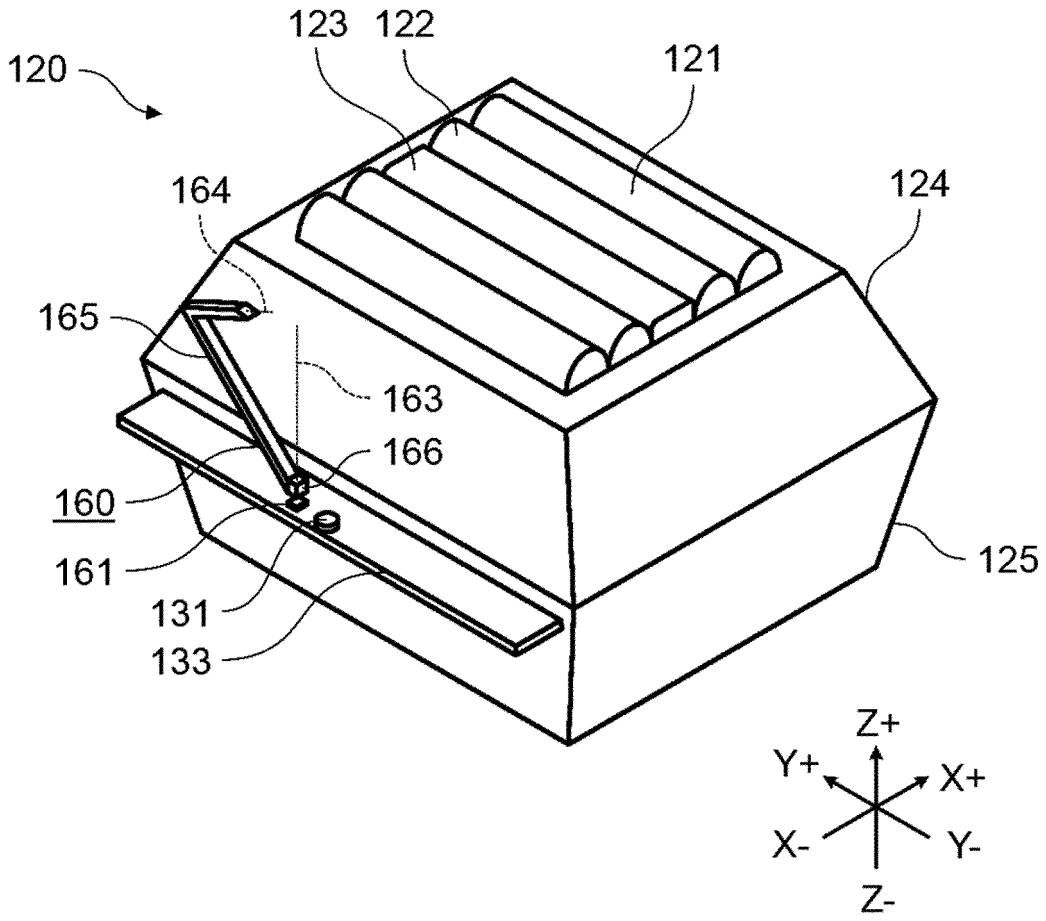

100
123
122
121
124
163
164
120
134
165
125
161
(160)
131
162
(160)
111
140
110
Z+
Y+
X+
X-
Y-
Z-

FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/002792

A. CLASSIFICATION OF SUBJECT MATTER

B26B 19/48(2006.01)i; ***B26B 19/46***(2006.01)i
FI: B26B19/48 C; B26B19/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B26B19/00-19/48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2016-97163 A (IZUMI PROD CO) 30 May 2016 (2016-05-30)	1-6
A	JP 2007-533391 A (KONINKLIJKE PHILIPS ELECTRONICS N.V) 22 November 2007 (2007-11-22)	1-6
A	US 2010/0186234 A1 (BINDER, Yehuda) 29 July 2010 (2010-07-29)	1-6
A	JP 2015-119942 A (S & Y ENTERPRISES LLC) 02 July 2015 (2015-07-02)	1-6
A	JP 2020-512064 A (KONINKLIJKE PHILIPS N.V) 23 April 2020 (2020-04-23)	1-6

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 April 2022	**19 April 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/002792

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2016-97163 A	30 May 2016	(Family: none)	
JP 2007-533391 A	22 November 2007	US 2007/0252997 A1	
		WO 2005/102153 A1	
		KR 10-2006-0134162 A	
		CN 1946335 A	
US 2010/0186234 A1	29 July 2010	US 2012/0317817 A1	
		US 2012/0320180 A1	
		US 2013/0250084 A1	
		US 2013/0250122 A1	
		US 2014/0320622 A1	
		US 2016/0001453 A1	
JP 2015-119942 A	02 July 2015	US 2013/0345685 A1	
		WO 2013/191864 A1	
		CN 104721968 A	
JP 2020-512064 A	23 April 2020	US 2020/0033448 A1	
		WO 2018/162512 A1	
		EP 3372357 A1	
		CN 110382182 A	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2016534806 W **[0003]**